Abstract

The current study is presented to investigate the thermal buckling and post-buckling response of functionally graded (FG) plates with temperature-dependent properties. Constituent properties depend not only on the thickness direction variable but also on temperature. Therefore calculation of the temperature distribution through the thickness is extremely significant. In this regard, an improved method is introduced for determining temperature distribution. Two types of uniform and nonuniform temperature distribution within the thickness are applied to the plate as thermal loads. Here, FEM is used to analyze the thermal buckling and post-buckling problem based on Carrera Unified Formulation (CUF), a powerful formulation and higher-order deformation theory for modeling the plate. In this regard, the nonlinear equilibrium equations are extracted using the virtual work principle by considering large displacements and Green-Lagrange strain. The solution to the problems in this thesis is divided into three general parts: First part is related to calculating the critical thermal buckling load of the FG plate with temperature-dependent properties using linear buckling analysis (LBA). The second part includes a nonlinear thermal post-buckling analysis of the FG plate using the arc-length method. The third part explains the procedure of analyzing the nonlinear thermal post-buckling behavior of the FG plate, considering temperature-dependent properties. In order to validate and prove the accuracy and effectiveness of the current method, several numerical examples are provided to show more precise results than similar references. In addition, some sensitivity analyses are executed to clarify the effects of the volume fraction index, the geometry aspect ratio and thickness of the plate, the order of expansion functions, the type of FGM combination, boundary conditions, temperature-dependent and temperature-independent properties on the thermal buckling load and thermal post-buckling path. The results prove the effectiveness of using CUF on thermal buckling and post-buckling of FG plates. It is illustrated that if temperature-dependent properties are utilized, the results will be more accurate than those without temperature

dependency. One significant result is that in a fully simply supported plate, it can not be seen the bifurcation point in the thermal post-buckling path, while it will be seen in the plate with fully clamped boundary condition.

Keywords: FG plate, Temperature-dependent properties, CUF, Geometrically nonlinear analysis, Thermal buckling and post-buckling, Expansion function